

STATE WATER RESOURCES CONTROL BOARD
RESOLUTION NO. 93-101

AUTHORIZATION TO ACCEPT GRANT FUNDS AND CONTINUE THE
COOPERATIVE AGREEMENT WITH THE NATIONAL OCEANIC AND
ATMOSPHERIC ADMINISTRATION TO STUDY BIOEFFECTS ASSOCIATED
WITH CONTAMINATED SEDIMENTS IN SOUTHERN CALIFORNIA

WHEREAS:

1. The State Water Resources Control Board (State Water Board) and the Regional Water Quality Control Boards are required by legislation (Porter-Cologne Act, Division 7, Section 13390 et seq.) to develop sediment quality objectives and identify toxic hot spots in the enclosed bays and estuaries of California.
2. The development of sediment quality objectives and identification of toxic hot spots will require the collection of sediment chemistry and biological data from the enclosed bays and estuaries of the State to evaluate toxicant-related bioeffects.
3. Congress requires the National Oceanic and Atmospheric Administration (NOAA) to collect similar sediment information throughout the United States.
4. The State Water Board has an ongoing Cooperative Agreement with NOAA to study the bioeffects of contaminated sediments in Southern California.
5. The State Water Board has applied to NOAA for a \$110,000 grant and proposed to continue the Cooperative Agreement for FY 1993-94 to study bioeffects associated with contaminated sediments in Southern California.

THEREFORE BE IT RESOLVED THAT:

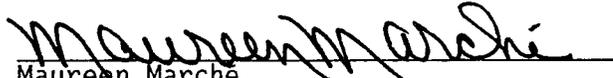
The State Water Board:

1. Authorizes the Executive Director, or his designee, to accept a grant of up to \$110,000 from NOAA and continue the Cooperative Agreement to study the bioeffects associated with contaminated sediments in Southern California.

2. Authorizes the Executive Director, or his designee, to negotiate, amend, and execute an interagency agreement with the California Department of Fish and Game to implement the Cooperative Agreement.

CERTIFICATION

The undersigned, Administrative Assistant, to the Board, does hereby certify that the foregoing is a full, true, and correct copy of a resolution duly and regularly adopted at a meeting of the State Water Resources Control Board held on October 19, 1993.


Maureen Marché
Administrative Assistant to the Board

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
AND
CALIFORNIA STATE WATER RESOURCES CONTROL BOARD

MEASURES OF BIOEFFECTS ASSOCIATED WITH TOXICANTS
IN SOUTHERN CALIFORNIA

YEAR THREE

PROPOSAL TO CONTINUE A COOPERATIVE AGREEMENT

DRAFT
JUNE 15, 1993

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
AND
CALIFORNIA STATE WATER RESOURCES CONTROL BOARD
PROPOSAL TO CONTINUE A COOPERATIVE AGREEMENT

MEASURES OF BIOEFFECTS ASSOCIATED WITH TOXICANTS
IN SOUTHERN CALIFORNIA

YEAR THREE

A. INTRODUCTION. The State Water Resources Control Board (State Water Board) and the National Oceanic and Atmospheric Administration (NOAA) propose to continue a Cooperative Agreement to assess adverse biological effects in the inshore waters of southern California. The program began in FY 1991-92 and this proposal is for FY 1993-94 (year three). In FY 1993-94, NOAA will provide \$110,000 to the State Water Board. The State Water Board will provide \$100,000 for the program from the Bay Protection and Toxic Cleanup fund. These funds will be used to determine the sediment toxicity of sites in enclosed bays and coastal lagoons in southern California, continue development of one of the two biomarker tests, and measure sediment chemistry on a limited number of samples.

This workplan is divided into several sections including Background, Rationale, Research Tasks for FY 1993-94, Reports, Benefits of the Research to NOAA, Benefits of the Research to California, Proposed Cooperative Agreement, Costs, and References.

B. BACKGROUND. NOAA is mandated by several acts of Congress to conduct a program of research and monitoring on marine pollution. Much of this research is being conducted through the National Status and Trends (NS&T) Program. The NS&T Program performs regional intensive studies of the magnitude and extent of toxicant-associated bioeffects in selected coastal embayments and estuaries. The areas chosen for these regional studies are those in which the contaminant concentrations indicate the greatest potential for biological effects. These biological studies augment the regular chemical monitoring activities of the Program and provide answers to the proverbial "So what?" question regarding toxicants. NOAA and the State of California have begun to conduct one of these intensive programs in Southern California over a three-year period. This workplan describes the cooperative research effort to be conducted in the third year.

The State Water Board and seven California Regional Water Quality Control Boards (Regional Water Boards) are mandated by the Porter-Cologne Act (California Water Code, Division 7, Section 13390 et seq.) to implement the Bay Protection and Toxic Cleanup Program (BPTCP). One activity of the BPTCP is to develop sediment quality objectives. The intent of the sediment quality objectives is to protect the beneficial uses of bays and estuaries, including protection of human health and aquatic life. The objectives are to be based upon scientific information, including but not limited to chemical monitoring, bioassays, or established modeling procedures, and are intended to provide adequate protection for the most sensitive aquatic organisms. A

Scope of Study. The study area extends from the Palos Verdes Peninsula south to the Mexico/USA border. It extends from approximately the 60 m isobath to the upper limit of tidal-influenced saltwater; however, most of the work will focus upon selected coastal bays and lagoons. In the first year, samples were collected in Los Angeles/Long Beach Harbor, San Pedro Bay, Anaheim Bay, Alamitos Bay, and Huntington Harbour.

In the second year, samples were collected in Tijuana Slough, San Diego Bay, San Diego Harbor, and Mission Bay. In the third year, it is anticipated that samples will be collected in Newport Bay, Bolsa Chica, Oceanside Harbor, and the numerous coastal lagoons located in the study area.

The research will involve biological and chemical analyses of sediments and resident demersal fish or mussels. Biological tests and chemical analyses will be performed with portions of each sample medium resulting in matching, paired data.

D. RESEARCH TASKS FOR FY 1993-94. Two research tasks are to be implemented in FY 1993-94: (1) measures of sediment contamination and toxicity and (2) measures of bioaccumulation and bioeffects in mussels or resident demersal fish. The details of the technical approaches and methods to be used in these two tasks will be described by the State of California. Specific details of sampling schedules will be determined jointly by NOAA and the State of California.

Samples will be collected at sites in each embayment that will serve at least two purposes: (1) to characterize the magnitude and spatial extent of toxicant-associated bioeffects in Southern California inshore areas; and (2) to determine relationships between concentrations and mixtures of sediment-associated toxicants, bioavailability and uptake of these chemicals, and the occurrence and severity of bioeffects. It follows that the grid of sampling sites selected to fulfill these two purposes must meet the following criteria: (1) the sites must be depositional (muddy) and, therefore, should represent recently deposited toxicants; (2) half of the sites must represent the integrated accumulation of toxicants from multiple nearby sources, while the other half must represent contamination in further need of assessment for toxic hot spot status; (3) the grid of sediment sampling sites must be representative of conditions throughout the study area; (4) the grid of sampling sites must be suitable for estimating the spatial extent of toxicant-associated bioeffects; and (5) a subset of the sediment sampling sites must have marsh or demersal fish available. Based upon these criteria and the programmatic goals of NOAA's NS&T Program and the State Water Board's Bay Protection and Toxic Cleanup Program, a balanced sampling strategy for sites in potentially highly toxic areas, in potentially moderately toxic areas, and in potentially reference (non-toxic) areas will be selected. Final selections will be performed jointly by NOAA and the State of California.

The data from the three years of research will be merged to form a synopsis of conditions in the study area. These data, in turn, will be compared with those from other parts of the study area that have been previously studied with similar methods. Data evaluations will be conducted jointly by NOAA and the State of California.

tested in the laboratory with five replicates. Each test will be accompanied with equivalent tests of a positive control chemical (e.g., cadmium chloride).

The amphipod tests will follow the protocols prepared by ASTM (1991) for performance of sediment toxicity tests with marine and estuarine amphipods. The end-point of survival will be reported. The urchin egg fertilization tests will be performed with the pore water (or interstitial water), which will be recovered using the protocols reported by Carr et al. (1989), and dilution series used by the NS&T study in Tampa Bay, Florida. End-points of the urchin tests will include fertilization success (Dinnel et al., 1987). During the tests, the concentrations of dissolved oxygen, ammonium, and hydrogen sulfide tests, the concentrations of dissolved oxygen, ammonium, and hydrogen sulfide will be determined along with pH, temperature, and salinity. The concentration of unionized ammonia will be calculated, based upon the pH and ammonium data, and reported.

Chemical Analyses. Portions of each of the sediment samples will be set aside and frozen for chemical analyses. Chemical analyses will be performed with as many of the samples as possible and feasible. Those samples that prove to be of interest to NOAA and the State of California following a review of the toxicity data will be analyzed for contaminant concentrations. The sediments from a minimum of twenty (20) samples will be analyzed. Chemical analyses will be performed for the trace metals, pesticides, hydrocarbons, and selected normalizers (e.g., grain size, total organic carbon) that are routinely quantified by the NS&T Program, plus TBT. Analytical procedures will comply with NS&T Program QA/QC requirements and will include those for analyses of blanks and standard reference materials.

Data Evaluations. The data will be evaluated to determine:

1. Which stations and sites were statistically significantly more toxic than controls;
2. Spatial patterns in toxicity;
3. Relative degree of toxicity among the sites;
4. Relationships between the toxicity and chemical data; and
5. Relative sensitivity of the two toxicity tests.

Statistical methods to be used for identification of significantly toxic sites will be chosen jointly by NOAA and the State of California. The relative degree of toxicity will be determined according to the mean results for each station and site and reported graphically and in tabular formats. The relationships between the toxicity and chemical data will be determined in regression analyses, cluster analyses, concordance tests, and other methods to be specified. In addition, the bioassay and chemical data will be entered into a project data base and accumulated in that data base. As each leg of the study plan is completed, the new data will be added to this data base.

Reports. The final report will include the descriptions of methods, the raw data in tabular spreadsheet format, the results of the five data evaluations listed above, and textual descriptions of the results.

Sufficient numbers of mussels will be sampled at each site to allow determination of statistically significant differences among sites, based upon the site means. The tissues of a sufficient number of animals will be composited from each site to provide the minimum amount needed for the full suite of chemical analyses.

Mussels will be collected, handled, and transplanted using standard, non-contaminating methods of the CMW Program. All biomarker and chemical analyses performed on transplanted mussels also will be conducted on control mussels collected at Bodega Head.

The number and final locations of sampling sites will be determined jointly by NOAA and the State of California. Mussels will be transplanted to and retrieved from these sites in the same sequence. Portions of the samples will be allocated for the biomarker and chemical analyses and transported to the participating laboratories as quickly as possible.

Biological Tests. The biomarker for the third year of the program is heat stress protein induction, DNA strand damage, a condition index, reproduction index, growth, or other measurements deemed appropriate by both the State Water Board and NOAA.

Chemical Analyses. Tissues from mussels collected at each site and from Bodega Head will be analyzed for the trace metals, pesticides, hydrocarbons, and normalizers quantified by the NS&T Program. Standard methods that comply with the NS&T Program QA/QC requirements, including analyses of blanks and standard reference materials, will be used during the analyses.

Data Evaluations. The data will be evaluated to determine:

1. The concentrations of toxicants in transplanted or resident mussels;
2. The quantification of mean biomarker results at each site and the identification of significant differences among sites and between the study sites and the controls;
3. The geographic patterns in the incidence of the measured biological effects; and
4. The relationships between the biological and chemical data.

The statistical methods to be used in the data evaluations will be determined jointly by NOAA and the State of California. The chemical signatures and absolute concentrations of contaminants in the sediments at each site will be compared with those in the mussels collected at the same sites. The relative sensitivity, range in response, within-site variability, and concordance with the tissue chemistry will be evaluated. Analyses will be performed to identify at which sites, if any, the mean results were significantly different from those in Bodega Head controls. The mean results will be evaluated to identify spatial patterns in results among the sites. The chemical data from the tissue analyses and the sediment analyses (from Task 1) will be compared with the biomarker data to identify any relationships and to confirm concentrations predicted by sediment-water and water-tissue equilibrium partitioning models.

Chemical Analyses. The liver and perhaps other tissues of the fish will be analyzed for the trace metals, pesticides, hydrocarbons, and normalizers routinely quantified in the NS&T Program.

Data Evaluations. The data will be evaluated to determine:

1. Relative bioaccumulation of sediment-associated toxicants in the tissues of the fish;
2. The presence/absence of statistically significant results among sites and between sites and reference or control sites.
3. The relative degree or severity of effects observed in each site; and
4. The relationships between the chemistry and biological data.

The statistical procedures to be used in the data evaluations will be determined jointly by NOAA and the State of California. The relative sensitivity, range in response, within-site variability, and concordance with tissue chemistry data will be determined. Sampling sites at which mean results are significantly different than controls will be identified. Mean results will be used to determine spatial patterns in response among the sampling sites.

E. REPORTS

- o Cruise report which will consist of station locations with longitude and latitude readings for each station and site, a chart indicating the location of all stations and sites, and field notes regarding the sampling success and visual condition of the samples.
- o A draft and final technical report of third year work which will include description of methods, raw data in tabular form, the results of the data evaluations, and textual descriptions of the results.
- o Draft and final summary and overview report of years one through three work. This report will be prepared jointly by NOAA and the State Water Board in cooperation with DFG.

F. BENEFITS OF THE RESEARCH TO NOAA

This research program in Southern California will provide a number of programmatic benefits to NOAA. They include:

1. Presence or absence of adverse biological effects in areas known to have relatively high chemical concentrations;
2. Data to assess the degree or severity of toxicant effects;
3. Spatial distribution of toxicant-associated effects in Southern California;
4. New data with which to supplement existing data on the relationships between toxicants and toxic effects in Southern California;
5. Matching biological and chemical data with which to perform statistical analyses;
6. Biological data with which to assess the significance of chemical data from the NS&T Program's monitoring activities; and
7. Evaluations of the relative performance of a battery of biomarkers.

I. COST ESTIMATES FOR FY 1993-94 COOPERATIVE AGREEMENT

Task 1. Survey of Sediment Contamination and Toxicity

Sample Collection

42 study sites @ \$1425 \$ 59,800

Toxicity Testing (2 tests)

42 study stations @ \$1000 42,000

Chemical Analysis

20 study stations
full organic scan + PAH @ \$1180 23,600
full metal scan @ \$900 18,000
TBT @ \$170 3,400
TOC @ \$50 1,000
Grain size @ \$40 800

Reports

5 Cruise @ \$500 2,500
4 Quarterly @ \$1250 2,000
1 Data report @ \$1250 1,250

Miscellaneous Services, expendables

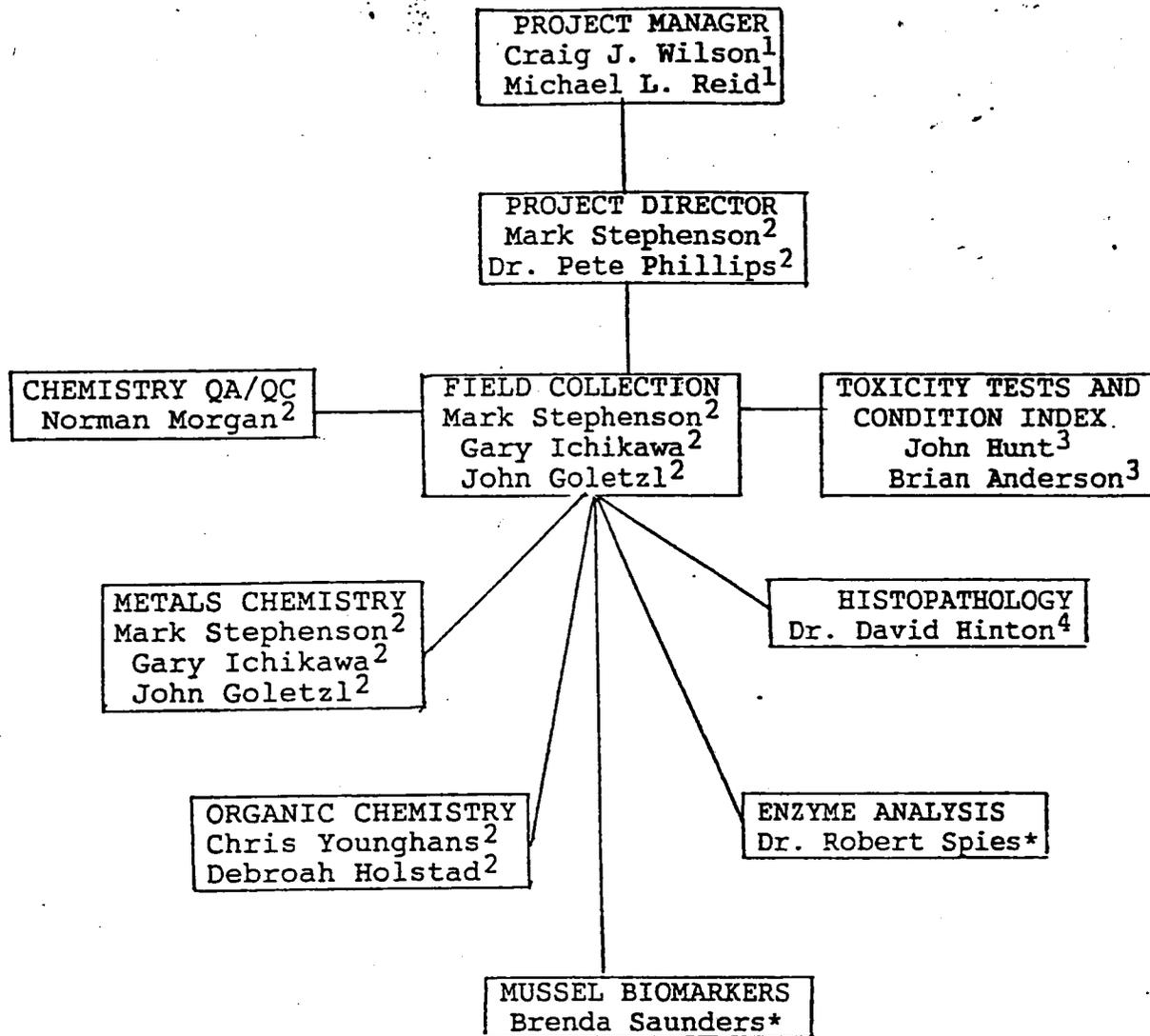
5,600

\$160,000

Task 2. Bioaccumulation and Biomarkers Study
Sample collections, biomarker tests,
chemical analyses, data evaluations, etc.
(please refer to text for explanation.)

\$ 50,000

\$210,000



- 1 State Water Resources Control Board
- 2 California Department of Fish and Game
- 3 University of California at Santa Cruz
- 4 University of California at Davis
- * Proposed Researcher